PIER –Environmental Area

- **Avian Research Program Wind Turbine Issues**

Linda Spiegel
June 28, 2005

PIER Goals and Objectives

- Provide a clean, reliable, affordable, and resilient supply of electricity to California
- Evaluate and resolve environmental impacts from electricity generation, transmission, and use
- Improving the environment, health, and safety
- Providing greater choices for California consumers

PIER-EA Program Areas

- Global Climate Change
- Aquatic Resources
- Indoor/Outdoor Air Quality
- **Land Use and Habitat**

Problem Statement

- California's economy is dependent on reliable and stable electricity supplies which requires adequate transmission systems and a mix of energy production sources.
- Avian collision and electrocution with generation and transmission systems are killing birds, stopping production of new generation, causing outages, and are increasingly becoming a concern to law enforcement, the public, and siting.

Energy Commission Studying Avian-Wind Issue Since 1989

- **CEC 1989**- Identified as problem
- **CEC 1992, 1996**- 1st in-depth studies, extent of problem, determined some species at greater risk
- 90's - Industry sponsored studies, bankruptcy, no results
- **CEC 1997**- Tehachapi/San Gorgonio; risk factor similar, fewer birds, fewer collisions
- NWCC 1999 - Guidelines for determining risk. Avoidance
- NREL 1994-97, GE fatality at Altamont, population declining rapidly
- **CEC 1998** - more logical model, population stable, but threatened.
- NREL 1998-01 determine numbers and identify risk factors
- **CEC 2001-03** - design quantitative risk model

Meeting Goals to Evaluate and Resolve Problems

- Renewable Portfolio Standard
  - Wind Energy Important to Meet Goal
- 1998 Moratorium at APWRA
  - *Cannot increase current capacity of 580 MW until demonstrable progress toward significantly reducing bird mortality*

APWRA- Important Source of Renewable Energy and Bird Use Area

- Provides ~ 30% of state's 3.5 billion kWhrs of energy
- Repowering potential
- High number of turbines ~ 5,400
- Variety of turbine types
- Complex terrain
- High bird use
  - Largest known GE nesting site in country
  - Winter Migratory Bird Use
  - Potentially Highest Known Burrowing Owl Density in CA

PIER-EA Research

Developing Methods to Reduce Bird Mortality in the Altamont Pass Wind Resource Area

August 04

P500-04-052

4-year research project at APWRA aimed to better understand and reduce high bird mortality

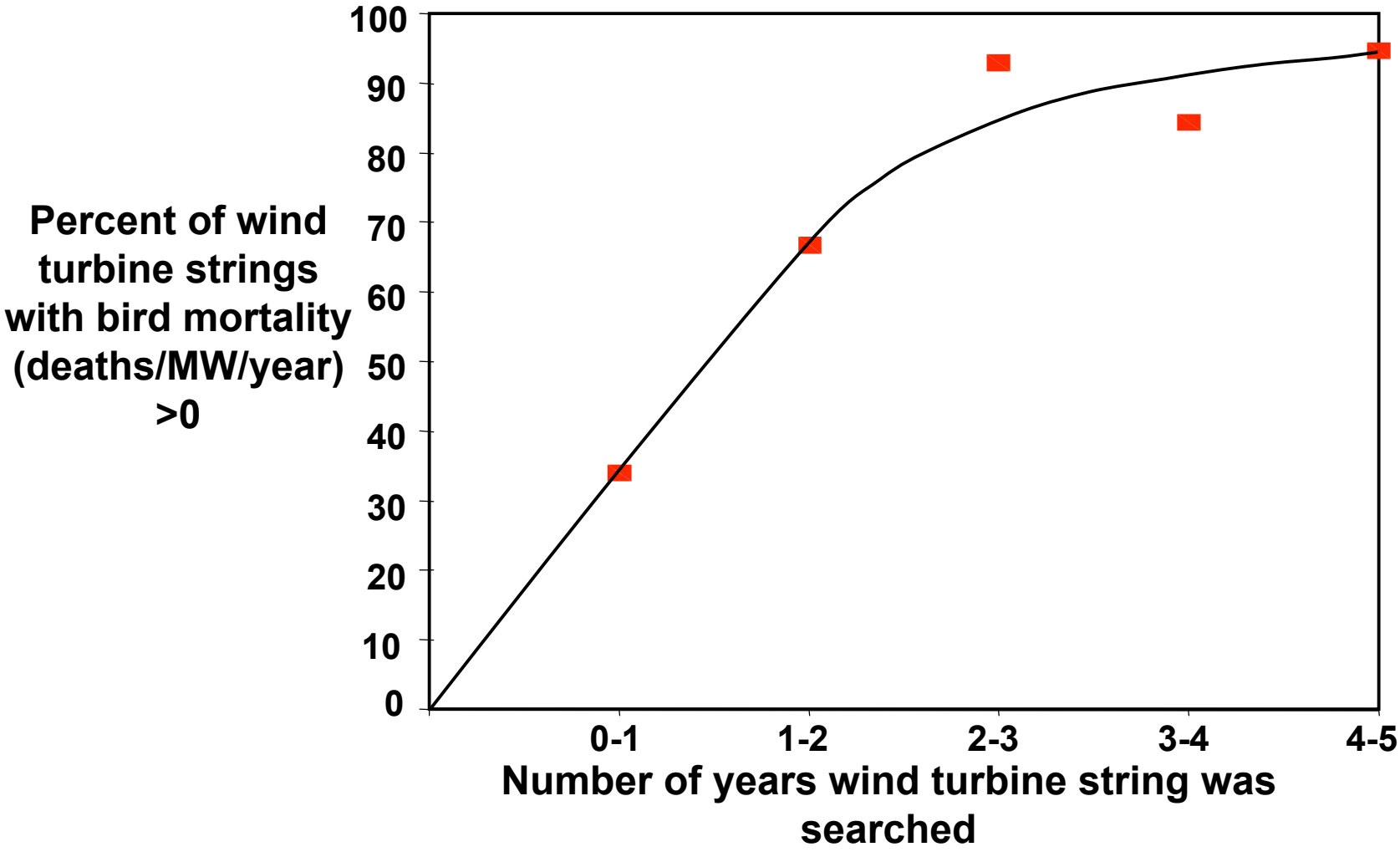
Study Objectives

- Identify fatality associations to turbine types & distribution, landscape, range management
- Relate bird behaviors to fatality
- Develop predictive models to determine collision risk based on causal factors underlying observed fatalities
- Develop mitigation measures
- Resolve bird mortality issue and support renewable development

Results Based on Robust Number of Data Points

- Behavioral Studies
  - 2,209 Sessions
  - 48,993 Sighting
  - 35,201 minutes bird activity
  - 29, 844 minutes raptor activity
- Fatality Searches
  - 1,526 turbines May 98 – Sept 02
  - 2,548 turbines Nov 02 – May 03

3 Years of Monitoring Necessary to Yield Reliable Results

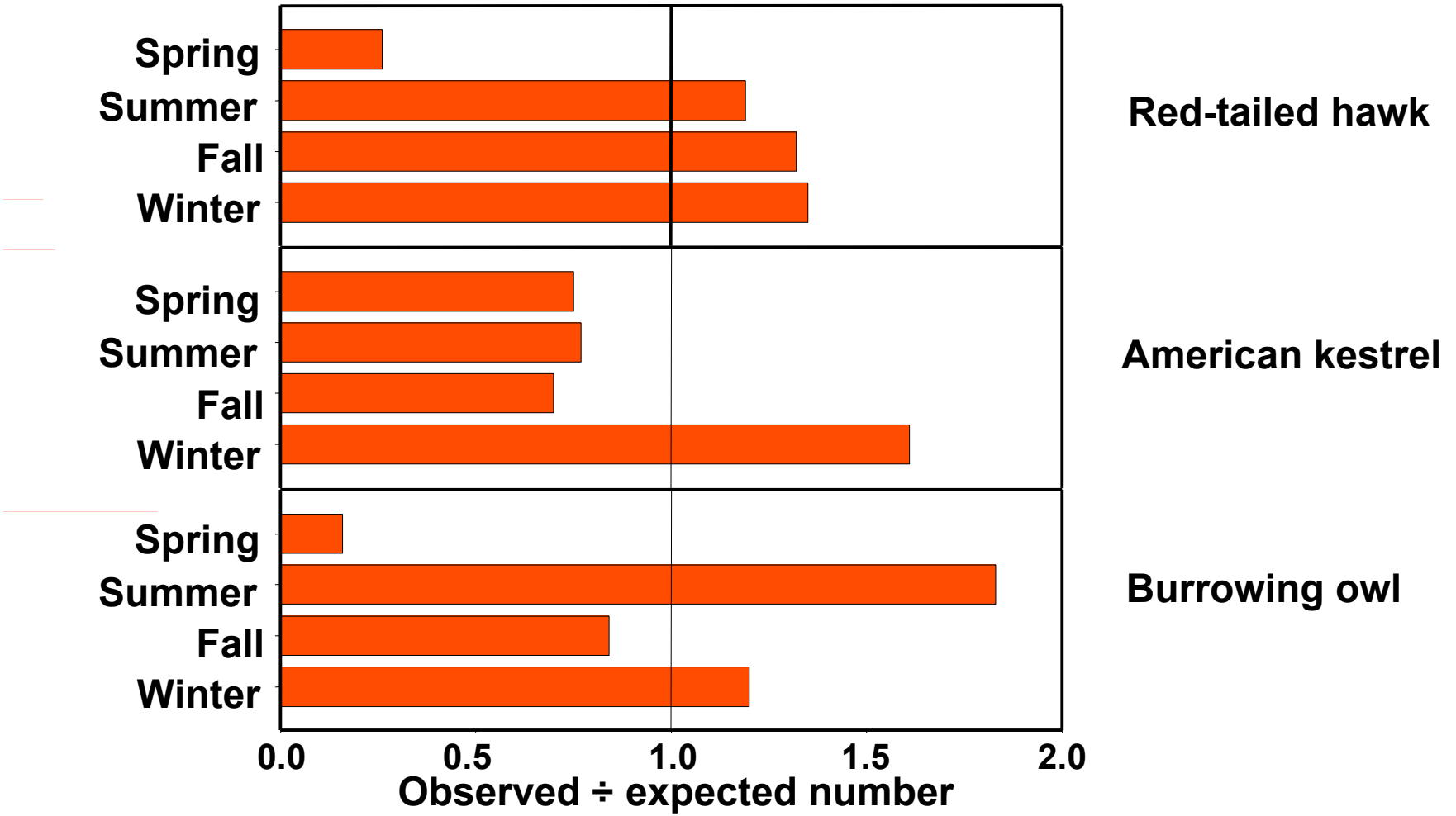


Annual Fatality Estimates Are Significant

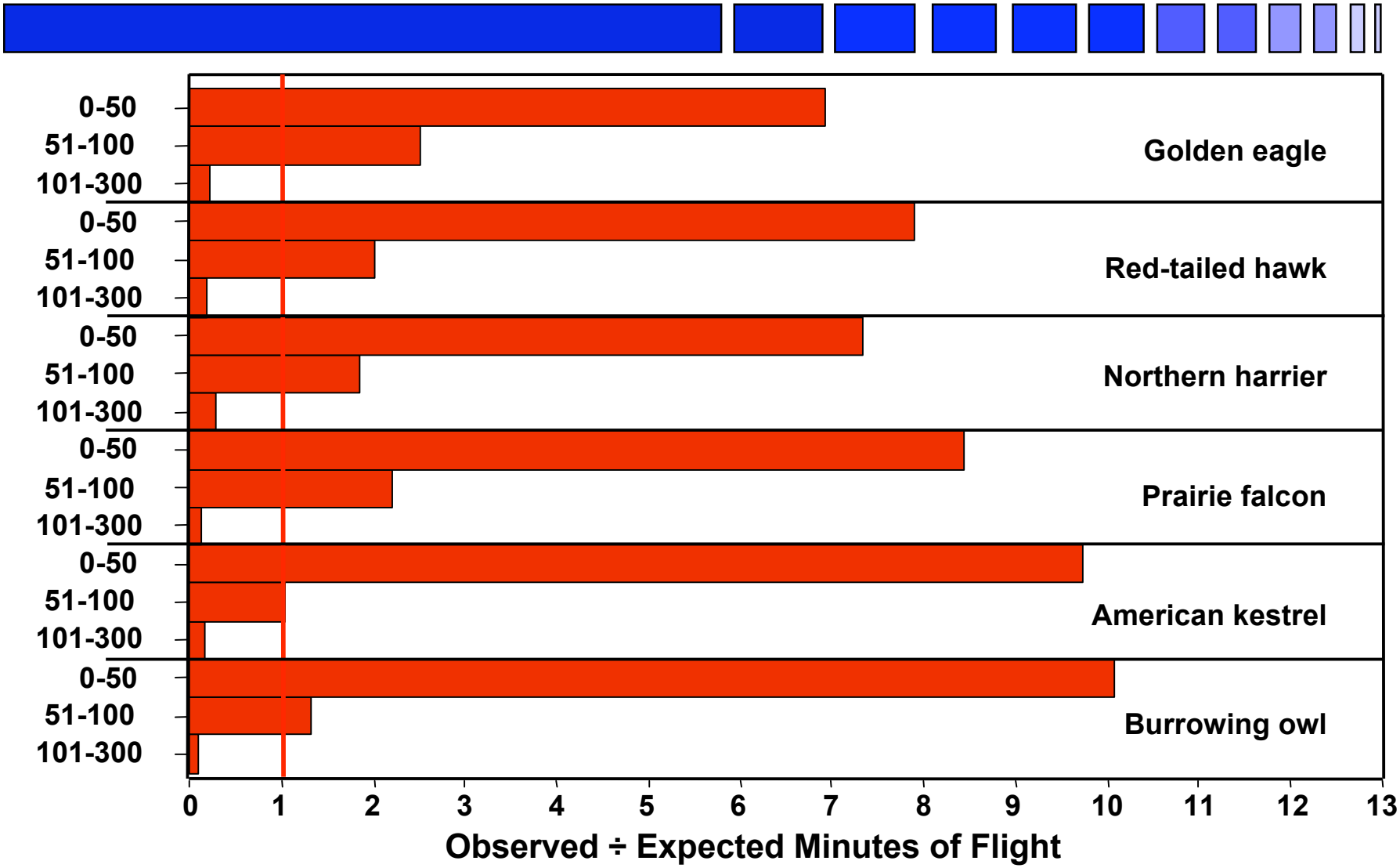
- 75 - 116 Golden Eagles
- 209- 300 Red-tailed Hawks
- 15 - 24 Ferruginous Hawks
- 73 - 333 American Kestrels
- 99- 380 Burrowing Owls
- 8- 10 Great Horned Owls
- 36- 49 Barn Owls
- 881 - 1,300 raptors

- 9 - 23 California Gulls
- 59 - 154 Mallards
- 116 - 704 Mourning Doves
- 309 -2,557 Meadowlarks
- 18 - 49 Common Ravens
- 23 - 115 Horned Larks
- 23 - 176 Loggerhead Shrikes
- 1,767 - 4,721 birds

Fatalities by Season

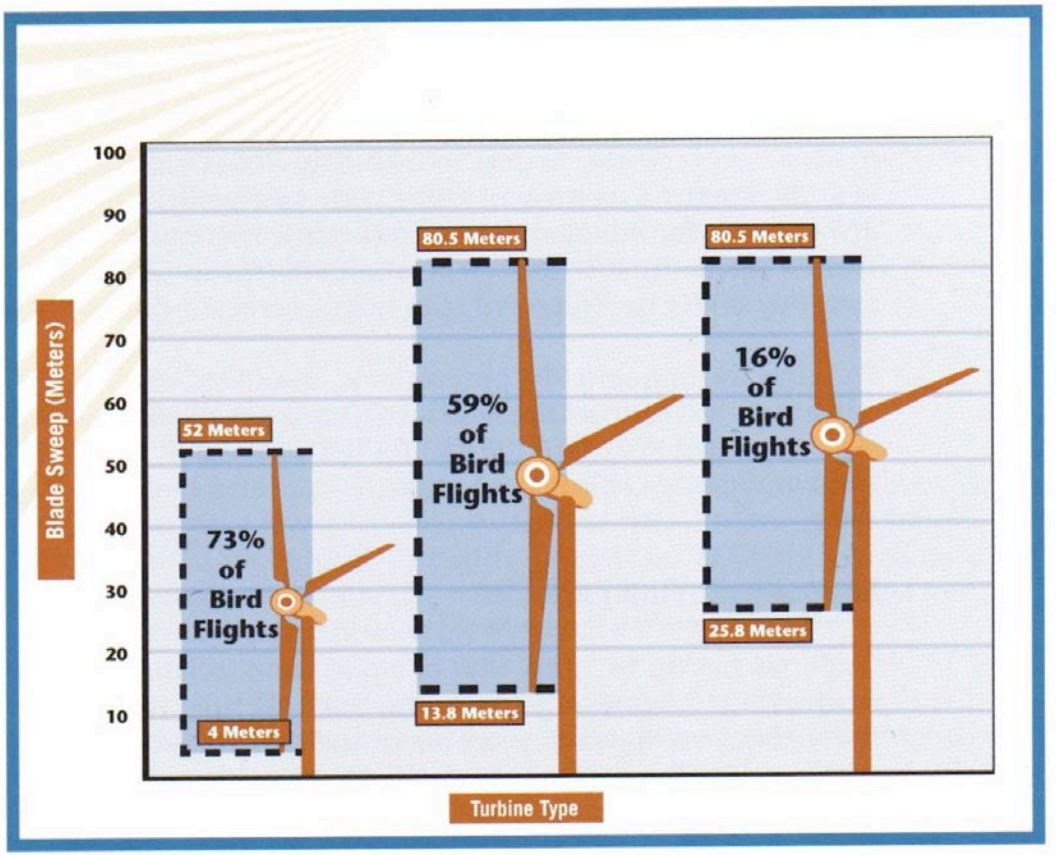


Proximity Zone Based on Distance to Nearest Turbine (m)



Repowering with Larger Turbines May Reduce Fatalities at APWRA

- Placing turbine blades high above ground may reduce incidence of collision
- Site Specific Solution
- Bird Behavior Data is Key



Source: *Developing Methods to Reduce Bird Mortality.*

Accountable Mortality = (Observed – Expected) ÷ Total fatalities × 100%

Variable	Magnitude of increase in Golden Eagle mortality
Height of lowest blade reach	+ 25% at turbines with lower reaches of blades
Whether in wind wall	+ 12% at turbines *not* in wind walls
Position in turbine string	+ 17% at the string end, 2% next to gaps
Location in wind farm	+ 12% at local cluster of turbines
Wind turbine congestion	+ 21% at turbines more sparsely distributed
Physical relief	+ 21% on ridgeline
Whether in canyon	+ 13% in canyon
Slope grade	+ 13% on steeper slopes
Edge index	+ 27% at sites with greater vertical edge
Rodent control	+ 14% in areas with no control
Cattle pats at wind turbines	+ 19% at turbines with more cattle pats

Predicted Impact = Σ accountable mortality

Some Significant Findings

- Raptors flying closer to turbines much more than expected, flying farther away from turbines much less than expected –land management attracting birds.
- Winter has highest fatality for most species
- Turbines in canyons, at the end of strings, or isolated have highest kills
- Most flights (73%) occur at blade zone of existing turbines – Most flights occur at windward side of slopes
- Blades placed 29m or higher above ground will avoid 84% of observed flights

Rodent Control not without Controversy

Some Recommended Mitigation

- Repower with tall towers that place turbine blades high above ground – place on leeward side of slopes
- Relocate or seasonally shut down selected, highly dangerous turbines
- Select low risk locations
- Cluster turbines to reduce gaps
- Monitor
- Off-site compensation
- Land management – implement practices that attract prey away from turbines

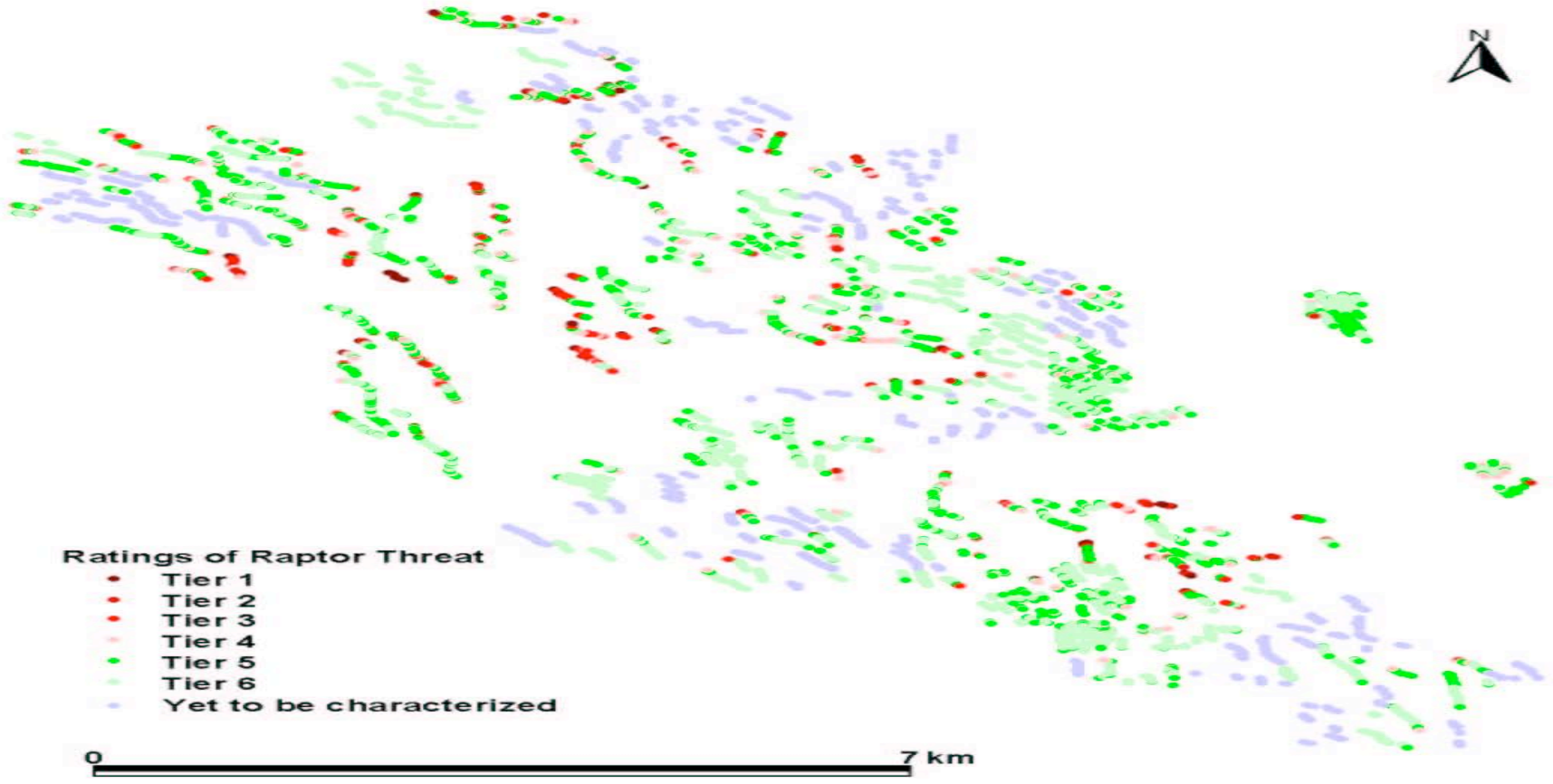
Working Together to Resolve Problem

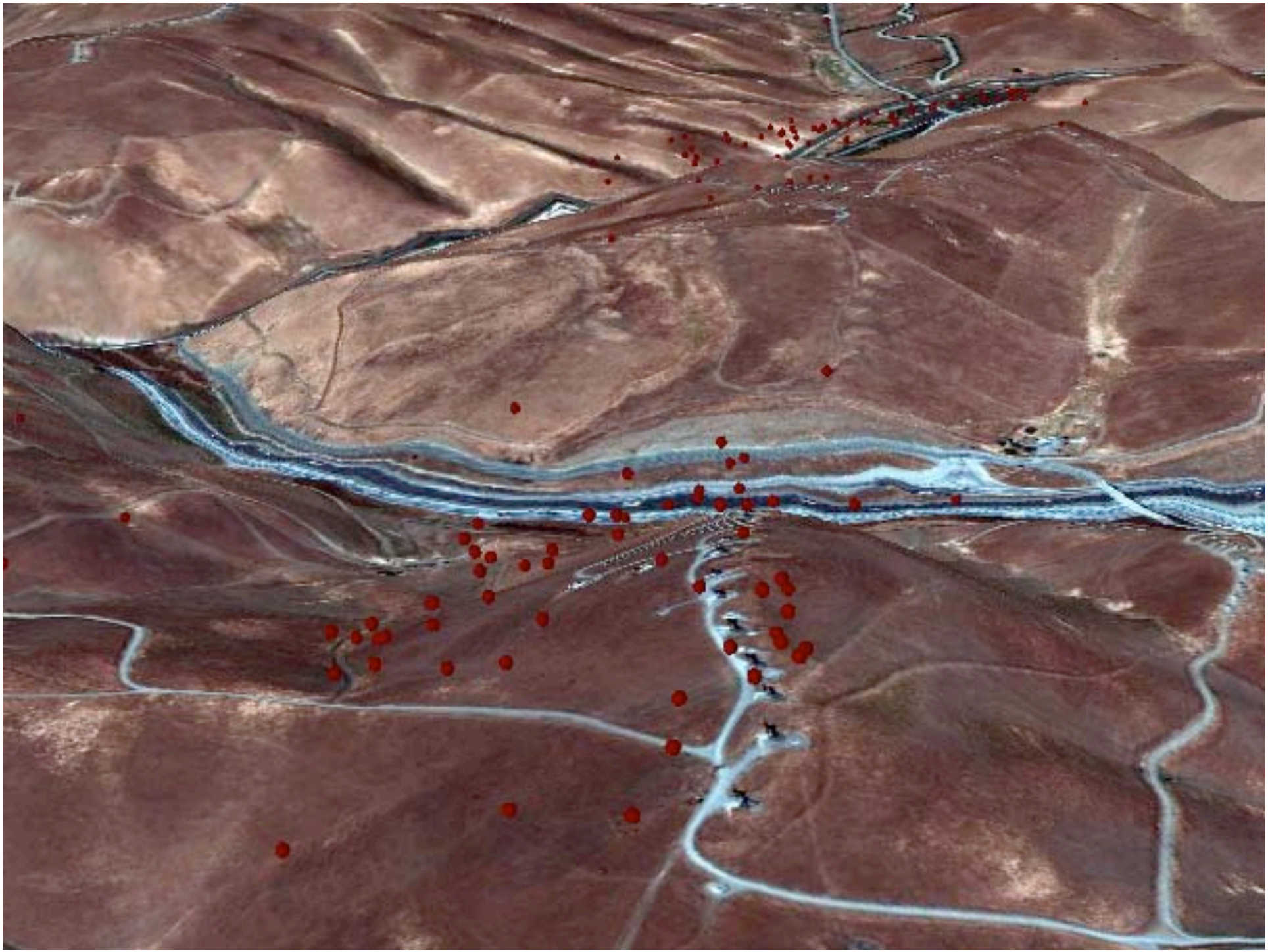
- APWRA operators
- Appellants
- Alameda County
- Commission Staff
- Sierra Club
- Land Owners

Industry Requested Model Outputs to ID High Risk Turbines

Tiers in Group A	Tiers in Group B	Tiers in Group C	No. of turbines	In Group C	
				No. of turbines	MW of capacity
1	1	1	54	**54**	**5.01**
1	2	2	64	**101**	**9.02**
2	1	2	37		
2	2	3	152	**152**	**15.23**
2	3	4	31	**297**	**27.60**
3	2	4	61		
3	1	4	12		
3	3	4	149		
1	3	4	43		
1	4	5	42	**1323**	**125.71**
2	4	5	116		
3	4	5	151		
4	4	5	788		
4	1	5	3		
4	2	5	12		
4	3	5	211		
5*	1*	6	2133	**2133**	**254.00**
		Total		**4059**	**436.58**

Helping Identify Highest Risk Turbines

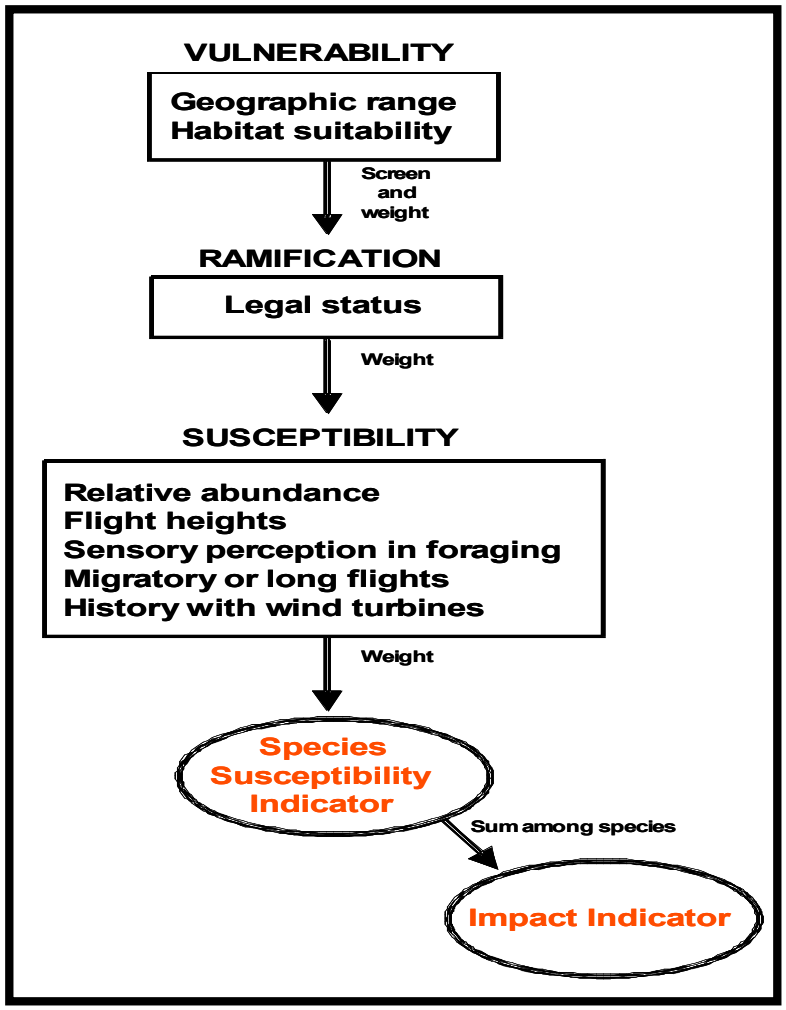




Studies to Determine Effectiveness of Recommended Measures

- Working with operators to develop scientifically robust study design to research effect of seasonal/permanent shutdown
- Working with other land owners to develop study design to research effect of land management practices

Proactive Approach to Future Wind Farm Locations



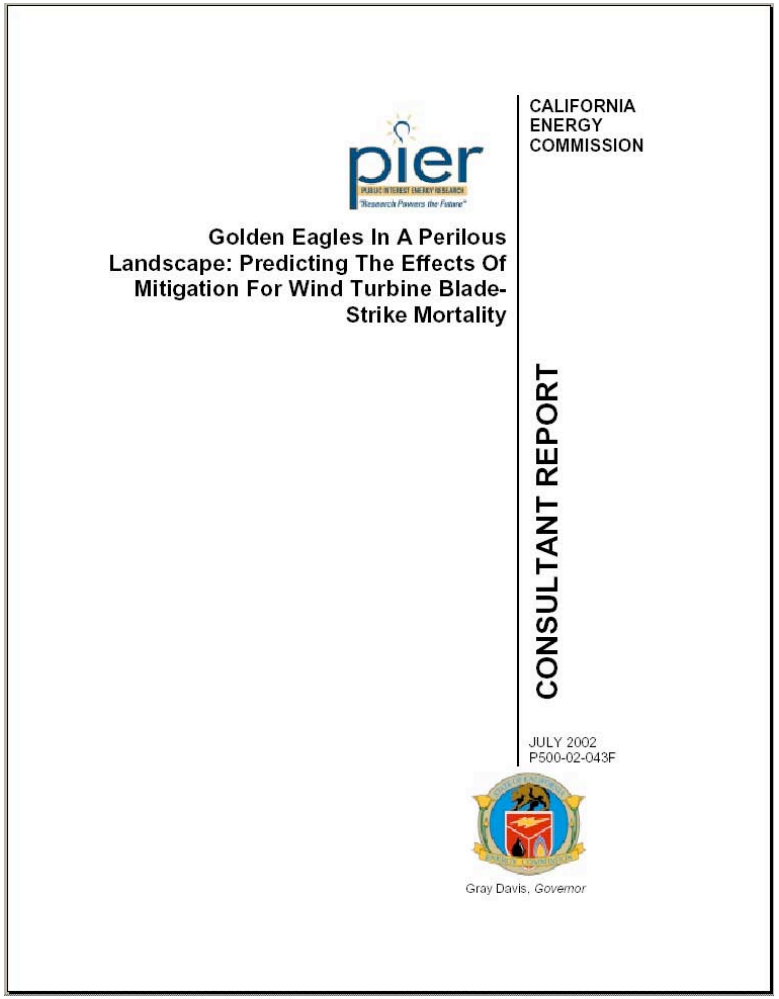
- **Screen potential wind sites for their likely impact to birds**
- **Intended for decision-makers and the public**
  - Consider the costs and benefits of wind development statewide
  - Prioritize where to site wind development

- **Step-By-Step Approach:**
  - Step 1: Score Vulnerability
    - » Habitat suitability, geographic range
  - Step 2: Determine Status
    - » listing by state and federal agencies.
  - Step 3: Score Susceptibility
    - » Natural history literature, experts, wind farms.
  - Step 4: Identify Potential Project Sites
    - » characterize by habitat, topographic features, and relative elevation.
  - Step 5 : Enter numbers into spreadsheet **=>Impact Indicator scores.**

Golden Eagle Study Adjusted Earlier Estimates of Rapidly Declining Population

- 100 deaths over 7-yr period (~ 40-60/year)
- 42% turbine caused (12% electrocution)
- mostly subadults and floaters (future breeders)
- floaters buffers breeding pop
- Adults nesting outside WRA - stay in territories
- Found - population +/- stable, no annual rate of change in productivity, but no production of floaters
- Any further decrease in survival or reproduction would only be mitigated by immigration of floaters

Publication:
Hunt July 2002 P500-02-043F



Follow Up Studies as Recommended

3-year review of golden eagle nest occupancy trend in the vicinity of APWR

Bats are a New Challenge to Wind Developments

Develop Cost Effective Collision Monitors

Feasibility Study:
- investigate contact and non-contact sensor technologies to record bird and bat strikes

Potential Technologies
- Accelerometers
- Fiber Optic Sensors
- Acoustic Emission Sensors
- Machine vision sensors
- Laser vibrometers

Phase II – prototype testing

Always a Challenge -

Thank you!

Linda Spiegel

Lspiegel@energy.state.ca.us

(916) 654 4703